Thesis/
Reports
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Standards and Applications of an Ecosystem Diversity Framework

Final Report: 00-JV-11222022-580

Standards and Applications of an Ecosystem Diversity Framework

Final Contract Report for
Agreement No. 00-JV-11222022-580
R. Pfister and M. Sweet
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I. PURPOSE

A. The overall objective of this agreement is to develop recommended standards for implementation and demonstration of applications of an Ecosystem Diversity Framework for western Montana.

B. Specific objectives for Phase One (September 1, 2000 through August 31, 2001) are as follows:

a. Determine the effects of alternative rule sets on summarizing existing vegetation inventory to describe existing conditions with at least two selected data sets as a basis to finalize recommended standards for components of the EDF.

b. Review the basis for linking existing knowledge to the EDF for evaluating existing landscape conditions.

c. Demonstrate and document applications of the EDF for at least two landscape analysis projects.

d. Continue collaboration with R-1 Pilot Project, Bitterroot NF, and Fiedler's Silviculture/Fire studies and Mission-Oriented Research Program demonstrations at Lubrecht Forest, Bandy Ranch, and Bair Ranch Foundation in Tenderfoot Creek.

C. The specific objective for Phase Two was to develop a manuscript for publication as a RM Station Research Paper incorporating recommended standards for an Ecosystem Diversity Framework (August 31, 2001 to August 31, 2003)

ACCOMPLISHMENTS BY OBJECTIVES

a) Effects of Alternative Rule Sets: Several possible data sets were reviewed for adequacy of data, and appropriateness for testing. These include the Montana FIA plots, MORP Permanent Plots, BELLA Plots at Lubrecht Forest (M.S. Thesis), and Lubrecht Stand Exam Data (1999). It would be desirable to use the Montana FIA plots because of concurrent efforts by other people. Three different rule sets have already been used to summarize the same data set: a) Atkins summaries using R-1 protocols, b) Fiedler's recent analyses of part of the Montana database for his Fire/Silviculture Research Project, and c) Standard FIA protocols conducted by Ogden FIA group for published inventory summaries. However, discussions with Rene O'Brien (RM Station, Ogden) revealed that they are putting their analysis efforts into producing published reports for each National Forest in Montana, but will not be providing a summary for Montana. I have also visited with Carl Fiedler about assisting in running another summary with a fourth protocol, especially for "Successional Stage" (Size Class), but time and funds were not sufficient to conduct additional analyses of their copy of the Montana FIA database.

Some of the 160 Bella plots were relocated and additional data collected in the fall of 2000 by German interns Martin Twer and Marion Blume with the possibility of them using them for a thesis. However, the fire season of 2000 interrupted their efforts and they were not able to complete the project. I planned to use the MORP permanent plots from Levels of Growing Stock and Uneven-Aged Management installations as a test and demonstration of alternative protocols for the EDF variables. Permanent photo points would provide photographic representation and data from 1982, 1987, 1992, and 1997 can be used to produce stand visualizations. Additional data were also collected for precise estimates of canopy cover for a recently completed M.S. thesis directed by Professor Tara Barrett. However, the Lubrecht plots are a very limited database and technical assistance was not available to help run the required analyses so this idea is on the shelf for possible future implementation.

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Continuing collaboration with the USDA, Forest Service, Northern Region Vegetation Council provided a golden opportunity to compare alternative protocols for classifying existing vegetation variables during an October 2002 Workshop and field trip. Through the leadership of Ken Brewer and Renate Bush (Co-chairs of the Vegetation Council) complete data sets were provided to all participants as they individually classified the stands in the field and discussed results. In addition, outputs from TSMRS, FIA protocols, FVS, and DESCRIBE were compared and discussed. It became obvious that stands could be placed in several different classifications, depending on which method was used and that additional work was needed to recommend standard procedures to identify the specified classes. The results of the field trips were summarized by Renate Bush and sent to all participants. (Appendix 1). A follow-up report was prepared by R. Pfister dealing specifically with displaying alternative rule sets for defining Dominant Cover Types, and Mixed Species Cover Types (Appendix 2). A summary table was also developed by R. Pfister to summarize the results of using alternative rules to define Size Class Structural Stage, Vertical Structure (Layering) classes, and Density (Canopy Cover) classes (Appendix 3). This information is also incorporated in the draft Standards manuscript (Appendix 4).

Analysis of a second data set was not accomplished. However, the current work on the Landscape Assessment RJVA No. 096 includes obtaining and analyzing the Bitterroot National Forest FIA data by R. Pfister and M. Twer. If time permits, we may be able to demonstrate the effects of alternative rule sets with that database after we have completed the required work for RJVA No. 096. Continued collaboration with the Region One Vegetation Council is anticipated beyond the scope of this RJVA because the standardization questions are not yet resolved and fully tested.

b) Linking Existing Knowledge to EDF: This is a continuing effort to collect additional management information that is clearly related to interpretation within the EDF classification framework. A general summary figure (Figure X) was developed to illustrate how different components have been used to address certain kinds of management questions.

Possible Management Interpretations	Site (1) (HT-HTG)	Comp. (2) (Spp.)	Stage (3) (Size of D)	Vert.(4) (Layers)	Density (5) (Can. Cov.)
Thermal Cover			X		X
Hiding Cover	X		X	X	X
Forage Production	X		X		X
Possible Old Growth	X	X	X		
B-D Coarse Filter	X	X	X	X	X
Potential Forest Prod.	X	X			
Generic Silv. Prescr.	X	X	X	X	X
WSBW Probabilities	X	X	X	X	X
Bark Beetle Probabilities	X	X	X		X
Forest Health Targets	X	X	X	X	X
Wildfire Risk of Loss	X	X	X	X	X
Ecosystem Burning	X	X	X	X	X
HC, EC, DFC Quantif.	X	X	X	X	X

Figure X -- Use of individual components of an Ecosystem Diversity Framework for developing management interpretations.

Many of these relationships have been incorporated into the SIMPPLLE model for predicting the probability of occurrence. Additional work is needed on this effort to cite literature demonstrating the application of the EDF variables to all the examples in Figure X. The following partial list of Literature

Citations all use one or more of the EDF variables (although not exactly the same class breaks) to develop risk indexes for Mountain Pine Beetle, Spruce Budworm and fire ecology characterization:

Brooks, Martha H., J.J. Colbert, R.G. Mitchell, R.W. Stark. tech coords. 1985. Managing Trees and Stands Susceptible to Western Spruce Budworm. USFS Cooperate State Research Service. Technical Bulletin No. 1695. Washington D.C.

Brooks, Martha H., R.W.Campbell, J.J. Colbert, R.G. Mitchell, R.W. Stark. tech coords. 1987. Western Spruce Budworm. USDA-Forest Service. Technical Bulletin 1694. Washington D.C.

Carlson, Clinton E., R.D. Pfister, L.J. Theroux, C.E. Fiedler. 1985. Release of Thinned Budworm-Infested Douglas-fir/Ponderosa Pine Stands. Res. Pap. INT-349. Ogden, UT. USDA Forest Service. Intermountain Research Station.

Carlson, Clinton E. And N. William Wulf. 1989. Silvicultural Strategies To Reduce Stand and Forest Susceptibility to the Western Spruce Budworm. USDA Forest Service. Cooperative State Research Service. Agricultural Handbook No. 676.

Stevens, Robert E., W.F. McCambridge, C.B. Edminster. 1980. Risk Rating Guide for Mountain Pine Beetle in Black Hills Ponderosa Pine. USDA Forest Service. Rocky Mountain Forest and Range Experiment Station. Research Note RM-385.

Oregon State University Extension Service. 1982. Thinning to Prevent Mountain Pine Beetles in Lodgepole and Ponderosa Pine. Stand Management. Extension Circular 1106. Sept. 1982.

Olsen, W.K., J.M. Schmid, S.A. Mata. 1996. Stand Characteristics Associated with Mountain Pine Beetle Infestations in Ponderosa Pine. Forest Science. 42(3).

Fischer, William C. and Anne F. Bradley. 1987. Fire Ecology of Western Montana Forest Habitat Types. USDA Forest Service. Intermountain Research Station. General Technical Report INT-223. April 1987.

c) Demonstration of Application on Two Landscape Analysis Projects: Work on a previous RJVA has utilized Stevi-WC and Bitterroot North BEMRP landscape analysis projects in collaboration with Dr. Jim Chew. Re-analysis of those data sets to match revised classification standards is not planned. Rather, we have been working with two smaller areas where we have familiarity with the data and can explore effects of varying the protocol for placing stands in types. During fall semester of 2000, we completed a landscape assessment exercise for all of Lubrecht Experimental Forest as part of a graduate student class. Robert Ahl coordinated preparation of a PowerPoint presentation (Ahl and Pfister 2000) and has prepared a draft of a Web Site summary of the landscape assessment that demonstrates the application of the EDF. In addition, Dr. Peter Kolb and his student and Martin Twer (landscape ecology intern from Muenster, Germany) completed a 100 percent stand inventory for the forestland on Bandy Ranch in the summer of 2000. Martin Twer used that inventory data along with previous data to develop a landscape assessment of Bandy Ranch for his professional Thesis spring semester at the University of Muenster (Twer 2001) (under the advice of Dr. Karl Holtmeier and Dr. Pfister). This provides a complete data set for existing forest vegetation at Bandy Ranch for possible additional analysis beyond his thesis. Additional work has been proposed with the Bair Ranch Foundation in Tenderfoot Creek. However, several changes in personnel in the Bair Ranch Foundation and a shortfall in research funding have put those efforts on a temporary hold.

d) Continued Collaboration: Dr. Pfister continues to participate in the R-1 Pilot Project discussions and review of progress on the mid-scale mapping efforts with the Northern Region Vegetation Council. Emphasis on defining classification systems that match remote sensing capabilities continues to be a frustrating exercise on a very difficult if not insurmountable challenge. Accuracy of mapping continues to be a problem. In February 2001,I was invited to participate in the planning session for the R-1 operational mid-scale vegetation mapping-planning meeting. In the summer of 2002, I conducted a training session on habitat type and existing vegetation classification for the Northern Region field crews collecting data for ground truth of the mid-scale mapping project. In October 2002 I was invited to participate in the Vegetation Council Workshop and field trip. (Described above under (a)).

Dr. Pfister is still an active member of the Ecological Society of America (ESA) Panel charged by the FGDC Vegetation Subcommittee with development of standards for Alliances and Associations. Most of the current interest among plant ecologists is focusing on a plot and ground-based plant community classification that is incomplete and currently non-operational because keys have not yet been written or tested. Annual draft manuscripts up to the latest one (Jennings and others 2003) are revealing that a single national standard meeting multi-resource landscape assessment will not be forthcoming. Furthermore, the relationships of inventory samples to present unbiased estimates of amounts of types over large areas will come from the sampling design and use of a taxonomic-based classification like the EDF. This will be the foundation for building management knowledge and management prescriptions. Maps of large areas for mid-scale planning may provide approximations of where these types occur, but accuracy in amounts will come from the sample data, not the maps. As a result, I am becoming more confident that the approach we are pursuing with the EDF will end up being a good foundation for plot, stand, and small landscape ecosystem classification.

As Forest Service ecologists, especially in the Northern Region, tried to work with the NVCS and the evolving Alliance and Association standards from the ESA, it became apparent that the Forest Service would need to develop their own additional standards to meet business requirements. In March 2001, Dr. Pfister was invited to participate in a meeting of the Forest Service national team charged with drafting new standards for vegetation classification and mapping under the direction of Ron Brohman. They were struggling with trying to implement the FGDC, TNC, and ESA evolving standards for a National Vegetation Classification System (NVCS) and have documented problems with the Physiognomic Levels as well as the Floristic Levels (Alliance and Association). Several members of the Forest Service team participated with the ESA Panel at a Workshop and meetings at the ESA national meeting in Madison, Wisconsin in the summer of 2001. (Some of the members have since been appointed to the ESA Panel.) In August 2002 the Forest Service developed draft handbook standards for classification and mapping of vegetation and revised them for field-testing in 2003 (Brohman and Bryant 2003). Dr. Pfister provided detailed review comments). At a joint meeting of the FGDC Vegetation Subcommittee and the ESA Vegetation Classification Panel in Washington D.C. in February 2003, it became apparent that these Forest Service efforts were a practical and necessary complement to the National Vegetation Classification efforts. The cooperative, exploratory efforts of BEMRP and the Northern Region have made major contributions to the national effort.

These national efforts are bringing national attention to the need for standard vegetation classification systems in order to conduct inventories and mapping at multiple scales. They provide a framework within which to implement regional, state, and local classification and mapping activities. Protocols and rules are being developed for definition of Alliances and Associations, but little effort is being directed to the practical necessity of developing rules for standard methodology to place individual plots in the same classification cells – the process of "identification". Continued collaboration is frustrating, but the ultimate solutions will come from collaboration, not from isolation.

Parts of the EDF were demonstrated in a presentation at the 2002 Governors Conference (Kolb and Pfister 2003). An overview of the various efforts to develop standards for classification of existing vegetation was also present in the Winter 2002-2003 issue of ECO-Report (Pfister 2003)

Phase Two –Manuscript for Station Publication: The focus of the planned publication is on standards for stand type classification. The scope of this publication is on the four components of the EDF that deal with existing vegetation. The manuscript represents an expansion and revision of a draft manuscript prepared in 1997 with several co-authors. That manuscript was not published because the structure of the National Vegetation Classification was unclear and because we realized that many people might agree with the proposed categories of the variables although there were no standard methods of assigning plots or stands to the cells of the proposed classification. The draft Forest Service National Technical Guide (Brohman and Bryant 2003) now provides a solid national framework for context and we have been able to explore the effects of using alternative rule sets to identify stand types. Our goal is to move this manuscript toward publication with the co-authorship and support of leaders in the field of vegetation classification in the Northern Rocky Mountains. The draft manuscript is appended to this report as Appendix 4. Publication of test results and continued collaboration will help move us toward formal operational standards for vegetation classification and mapping that are the most appropriate for specific information needs, efficient, and reasonably accurate.

References

Ahl, Robert and Robert Pfister. 2000. Landscape assessment of Lubrecht Experimental Forest. Power Point Presentation of Forestry 595 Class Project, Fall 2000. (Revised in 2001 and 2003 by R. Pfister)

Brohman, R. J. and L. D. Bryant, (editors). 2003. Existing Vegetation Classification and Mapping Technical Guide. Review Draft April 2003. USDA Forest Service, Washington Office Ecosystem Management Coordination Staff

Jennings, M., O. Loucks, D. Glenn-Lewin, R. Peet, D. Faber-Langendoen, D. Grossman, A. Damman, M. Barbour, R. Pfister, M. Walker, S. Talbot, J. Walker, G. Hartshorn, G. Waggoner, M. Abrams, A. Hill, D. Roberts, D. Tart. 2003. Guidelines for describing associations and alliances of the U. S. National Vegetation Classification. The Ecological Society of America Vegetation Classification Panel, Draft Version 2.0, March 28, 2003, 141 p. (Available on Website, Contact: Lori Hidinger lori@esa.org

Pfister, Robert. 2003. The Road to Vegetation Classification and Mapping Standards. In: Bitterroot Ecosystem Management Research Project, ECO-REPORT Winter, 2002-2003. USDA Forest Service, Rocky Mountain Research Station.

Kolb, Peter F. and Robert D. Pfister. 2003. Ecology of Montana Forest Systems. In: Kolb, Peter F. (Editor). 2003. The Governors Conference on the Future of Montana's Forests; Crafting a Vision for Landowners and Managers. The Montana Forest and Conservation Experiment Station, Missoula, MT. 63 p. + app.

Twer, Martin. 2001. A landscape assessment as foundation for a multiple use planning process for the Bandy Ranch, Ovando, Montana, U.S.A. Diploma Thesis, Westfalisch Wilhelms-Universitat Munster, Istitut fur Landschaftsokologie, Germany and The University of Montana, School of Forestry, Montana Forest and Conservation Experiment Station, Missoula, Montana, U.S.A., 66 p. + Appendix.

Appendix 1

Vegetation Council Meeting Notes – 10/02 meeting (last modified 11/12/02) by Renate Bush (R-1)

Overview:

This year's Vegetation Council Meeting addressed comparing various methods for classification of stand structure: vertical continuity, canopy closure, cover type, and size. An overview of various classification methods and applications were discussed the first day. See appendix A for software information and appendix B for overview on TSMRS.

Monday, October 7

1:00	Goals for the Meeting / Ground Rules / Agenda	Ken Brewer, Renate Bush
1:30	Overview of Existing Classification Approaches	Bob Pfister
2:00	Forest Vegetation Simulator's (FVS) Structural Classification	Nic Crookston
2:30	Describe's Structural Classification System	Jim Chew
3:00	Break	
3:30	FIA's Classification System	Renate Bush
3:45	TSMRS Classification System	Art Zack
4:00	National Vegetation Classification and Mapping Update	Ron Brohman
4:30	Update on Vegetation Mapping Project	Doug Berglund

Tuesday, Wednesday, and Thursday were spent in the field on the Bitterroot, Lolo, and Idaho Panhandle National Forests. Stand exam data had been collected earlier in the season on stands that were visited. A tree list from the stand exam and tables and graphs that summarized trees per acre, basal area, and canopy cover by species and diameter class were provided, see appendix C for the stand tables. Time was then allowed for attendees to look at the stand and the handouts. Participants then filled out a worksheet to summarize how they felt the stand should be classified in regards to cover type, size, canopy closure, and layering. Compilations of these composition and structural classifications are found in appendix D. Finally, output from Describe, the Forest Vegetation Simulator, and Forest Inventory and Analysis (FIA) systems were compared to individual calls and discussed, see appendix E for software outputs.

Attendees:

Monday: Vic Applegate, Jim Barber, Doug Berglund, Barry Bollenbacher, Ken Brewer, Ron Brohman, Renate Bush, Jim Chew, Nic Crookston, Marty Gmelin, Pat Green, Terry Jain, Dan Leavell, Renee Lundberg, Mary Manning, Tom Martin, Rosa Nygaard, Bob Pfister, Fred Samson, Rob Seli, Steve Shelly, Red Taylor, Bill Wulf, Art Zack

Tuesday: Doug Berglund, Barry Bollenbacher, Ken Brewer, Ron Brohman, Renate Bush, Nic Crookston, Marty Gmelin, Pat Green, Terry Jain, Dan Leavell, Renee Lundberg, Mary Manning, Bob Pfister, Bill Wulf, Art Zack

Wednesday: Doug Berglund, Ken Brewer, Ron Brohman, Renate Bush, Nic Crookston, Marty Gmelin, Pat Green, Terry Jain, Dan Leavell, Renee Lundberg, Tom Martin, Bob Pfister, Rob Seli, Kandi Staley, Art Zack

Thursday: Doug Berglund, Ken Brewer, Renate Bush, Nic Crookston, Marty Gmelin, Pat Green, Terry Jain, Dan Leavell, Tom Martin, Bob Pfister

Results

Prior to this field trip, it was felt that after validation in the field, one classification system would be selected as the standard classification "rule set" used in this Region. However, for various reasons, it became obvious that this was not possible. See Table 1 for an overview of "issues" that were observed during this meeting and some proposed solutions.

Table 1. Issues observed during the meeting.

	Classification	Problem	Solution
1	FVS & Describe	Unable to distinguish between "Continuous" canopy layers and a "single layer".	Structure classification algorithms need to identify "vertically continuous" canopy separately from "single layer".
2	FVS	Default input for structural classification statistics, such as minimum percent cover, that must be exceeded for a potential stratum to qualify as a valid stratum, work best if set specifically on a stand by stand basis. This makes classification of many stands in a meaningful manner cumbersome.	Explore if structural classification keywords that are dependent upon habitat type groups may give better classification results.
3	FVS	Need the presence of remnant canopy layer that is not greater than the threshold cover percent to identify an additional invalid layer.	Need to figure out an algorithm that recognizes remnants, not as a stratum, but as being there. Potentially remnant canopy could be classified as invalid strata. Could work with structural classification keyword, maybe a layer with less than 10% canopy cover is invalid. This is related to #2 above.
4	FVS	Ohara/CRB structure class label reported in FVS are not reflecting actual stand structural class.	Nic Crookston is aware of the problem. In the interim, do not use structural class label.
5	FVS	Structure classification is based on gap in tree heights. Bimodal distributions of size classes were not identified as more than one-story.	Classification system needs to take more information into account than heights of trees.
6	Describe	There currently is a shortage of funding and time available in maintaining / updating Describe logic. All of Jim Chew's energy is in Simpplle development, training, and maintenance.	If this Region is interested in having Jim address the problems with Describe, money is needed.
7	Describe	Describe density class seems to be consistently underestimated from what was seen in field observations and stand summaries. The actual canopy cover is sometimes being misclassified.	Notify Jim Chew about problems. In the interim, use density classes with caution.
8	Describe	Describe Dominant story species coverage is inconsistent with Describe simple species coverage. Canopy computation seems to have some	Notify Jim Chew about problems. In the interim, use dominant story species with caution.

		inconsistencies.	
9	Describe	Size / structure classification for one multistory stand visited was labeled as seedling sapling, see stand 522.	Notify Jim Chew about problems. In the interim, use size/structure classification with caution.
10	FIA, TSMRS, Describe	Some labels, such as size class names are confusing and inconsistent from one application to the next.	Use numeric diameter ranges as labels for size class. Recommend using national standards for diameter classes 5,10,15, etc.
11	FVS, Describe	Horizontal diversity of stands needs to be addressed. Oftentimes this diversity seemed to indicate multiple stories, which both structure classification algorithms missed.	Possible solutions should be addressed by Vegetation Council in 2003.
12	TSMRS	TSMRS calls on size, cover, density are subjective and should be more consistent. See appendix B.	Inconsistencies have been noted. Need to review usefulness of TSMRS at the Regional level and determine if things need to be fixed. Need to determine consistent method to calculate size, cover, and density based on stand exam data. This will enable consistent labels to be applied.
13		Density classes need to be consistent with FGDC classes / breaks.	Use FGDC/NVCS/USDAFS national standard breaks.
14		What is perfect stand exam sample design for classifying canopy cover and stand structure.	Literature review and address with stand data from VMP project.
15		No one classification software fits everyones needs. Oftentimes, at the stand level, a report with a variety of information is useful.	Provide multiple approaches (tool kit) for assigning cover, size, and layering to a stand. Analysis objectives should be the basis of selection of which labels are appropriate to use.
16		Need a simpler classification system for landscape analysis.	Provide, more generalized labels, as reflected in the national protocol, for broad scale analysis. Need final classification system to have a finite number of categories at the landscape level that are derived from collapsing more specific labels at the stand level.

Region 1's Reporting and Mapping Needs

Following is suggested output for a Stand Classification Report based on data that resides in the FSVeg database.

- Canopy Layering – Work with FVS logic to enhance its current capabilities. Algorithm needs to recognize single verses continuous story and stands that have bimodal distributions of diameter.
  - At the stand-level, include species composition and canopy cover by stratum.
- Tree Size Class – Work with stand data collected for Veg Council session to determine what appropriate size determination algorithm should be. Attendees indicated that size class should be determined from predominant overstory layer(s) and not be greatly affected by seedlings. Attribute may be derived from: average DBH of 40 largest trees, average dbh of top 40% largest

trees, average diameter of trees in top 50% of basal area distribution, 70th or 90th percentile tree in the distribution of net cubic foot volume. One suggestion for size classes are: 0-4.9", 5.0-9.9", 10.0-14.9", 15.0-19.9", 20.0-29.9", 30.0-39.9", 40.0-49.9", 50.0"+. Another suggestion is 0-4.9", 5.0-8.9", 9.0-14.9", 15.0-20.9", 21.0"+.

- At the landscape level, diameter classes could be collapsed into much broader classes.

- Total Canopy Cover
  - Stand Level: Report model projections to 1% cover.
  - SILC III and R1-VMP Maps: Collapse canopy cover to classes that reflect the map level and required detail.
- Canopy Cover Type
  - Stand Level: Report single species if 66%+ canopy cover, multiple species label if 2 or more species comprise at least 66% canopy cover, otherwise label as mix.
  - SILC III and R1-VMP Maps: Map single species if 66%+ canopy cover, multiple species label if 2 or more species comprise at least 80% canopy cover, otherwise label as mix.
- Basal Area Cover Type
  - Stand Level: Report single species if basal area is 66%+ of total basal area, multiple species label if 2 or more species comprise at least 66% total basal area, otherwise mix.
- Habitat type classification including author identification to clarify duplicate types.

STAND ID 453

			PP	DF	L	GF	WP	C	WH	LP	ES	AF	OT	Total
Trees/Acre	YEAR	TPA: < 5"	0	118	0	0	0	0	0	197	0	395	0	711
	2002	TPA: 5 - 9.9"	0	44	0	0	0	0	0	262	0	44	0	351
		TPA: 10 - 14.9"	0	6	0	0	0	0	0	22	0	6	0	35
		TPA: 15 - 19.9"	0	13	0	0	0	0	0	0	0	6	0	19
		TPA: 20 - 24.9"	0	4	0	0	0	0	0	0	0	0	0	4
		TPA: > 25"	0	2	0	0	0	0	0	0	0	0	0	2
		Total	0	187	0	0	0	0	0	482	0	452	0	1121

			PP	DF	L	GF	WP	C	WH	LP	ES	AF	OT	Total
Basal Area	YEAR	BA: < 5"	0	0	0	0	0	0	0	0	0	0	0	0
	2002	BA: 5 - 9.9"	0	13	0	0	0	0	0	82	0	13	0	108
		BA: 10 - 14.9"	0	6	0	0	0	0	0	15	0	5	0	27
		BA: 15 - 19.9"	0	19	0	0	0	0	0	0	0	9	0	28
		BA: 20 - 24.9"	0	10	0	0	0	0	0	0	0	0	0	10
		BA: >25"	0	8	0	0	0	0	0	0	0	0	0	8
		Total	0	56	0	0	0	0	0	97	0	28	0	181

			PP	DF	L	GF	WP	C	WH	LP	ES	AF	OT	Total
Canopy Cover	YEAR	CC: < 5"	0	0	0	0	0	0	0	0	0	2	0	3
	2002	CC: 5 - 9.9"	0	11	0	0	0	0	0	33	0	8	0	51
		CC: 10 - 14.9"	0	4	0	0	0	0	0	7	0	2	0	12
		CC: 15 - 19.9"	0	7	0	0	0	0	0	0	0	2	0	9
		CC: 20 - 24.9"	0	5	0	0	0	0	0	0	0	0	0	5
		CC: >25"	0	2	0	0	0	0	0	0	0	0	0	2
		Total	0	29	0	0	0	0	0	40	0	14	0	84

Figure 9 – Example of Stand Table Summary by Size Class for Number of Trees, Basal Area and Canopy Cover. (Stand #458 from USDA, FS, R1 Vegetation Council Workshop, October, 2002.)

Appendix 2

Observations on Stand Type Classification Relative to the October 2002 R-1 Vegetation Council Workshop and Field Exercise. -- R. D. Pfister February 22, 2003

Thank you for the opportunity to participate in the workshop and field trip. The workshop and field trip were well planned and executed. The complete data presentation and summaries for all stands provided a good foundation fore exploring alternative methods of classifying stand types as a taxonomic foundation for data analysis and mapping of existing vegetation.

The wrap-up discussion on Friday and the summary notes by Renate Bush (December 16,2002) provide good documentation of major points that surfaced during the field exercise. I think most people were surprised at the wide amount of variability in classification outcome based on formal and informal rule sets used to assign a "stand type" to an individual stand. This certainly emphasizes the fact that if we do not have a set of "reference standards" we will have difficulty communicating among ourselves as well as with other groups.

Summary of 10 stands: Enclosed you will find a summary of applying two different rule sets for assigning dominance type to the 10 stands classified on the October field trip. The Excel spread sheet lists basal area and canopy cover as provided and calculations of relative basal area and relative canopy cover by species. The first rule set applied is from the Pfister, et. Al. 1998 draft manuscript on proposed standards: [80/20 -- Consider all species that have at least 20%, pure type if one species >80% (like SAF), list in order of abundance to name the type, hierarchical set of types at two levels of generalization]. The second rule set is R-1 (Brewer-personal communication) where consider only species >20%, arrange in rank order, pure if single species >66%, dual if 2 qualified (>20%) species >66%, and "mix" if not qualifying above. (I labeled these as AF-mix, or DF-mix, rather than just "mix) because then they fit within an obvious single and two-level hierarchy whereas mix is not connected to anything.) I also ran this for both relative basal area and relative canopy cover to arrive at four possible classifications for the 10 stands. In only 3 of 10 stands did all four outcomes agree. In 7 of 10 stands, BA and CC gave the same dominant species. In only 2 of 10 stands did the 80/20 or 66/20 rules give different stand types, and then only on the basis of BA, not CC. This is a small sample, but large enough to demonstrate again (what Renate already documented) that choice of rules is very important.

Figures for Dominance Type Classification: I have also enclosed figures illustrating the alternative species dominance classification concepts for stands consisting of two species and three species. The bar-diagram illustrates the simple case with 4 possible outcomes. (I think it is important to track that A-B is not the same as B-A. If you lump these as an A-B mix you cannot aggregate into a single-level dominance hierarchy. Order of species in a dual name is critical, even if it results in more types.) Figures 1 & 2 represent an 80/20-rule set. Table 2 illustrates rules for assigning types consistent with the figures. Figures 3 & 4 represent a 66/20-rule set. Table 4 illustrates rules for assigning types consistent with the figures. This figure is not exactly the same as the 66/20 rule because I did it without the >20 rule and was not sure if you wanted any three species names or the specific rules regarding defining "mixes." Please

provide some feedback and I can revise these figures to match what you want to see. I think the 3-species stand offers sufficient complexity to help define the rules. A four-dimensional figure would obviously be overkill, if I could even figure out how to draw it!

In December, I provided Ron Brohman a detailed review of the taxonomic standards in the proposed national USFS Vegetation Classification & Mapping Standards document (August 2002). I commend the national team for taking a leadership role in this timely effort. After several years of participation on the ESA Vegetation Classification panel it has become evident to me that the focus on standards for floristic types (Alliance and Association) is primarily on specifying the standards needed to build that hierarchy, rather than on providing interim standards on using the current incomplete, provisional list of Alliances and Associations maintained by NatureServe (formerly TNC). (I also was invited to participate in the FS National Team conference call (February 10) regarding suggested revisions for the draft that will be released for pilot testing in the near future).

I just attended the joint meeting of the FGDC Vegetation Subcommittee and the ESA Vegetation Classification Panel in Washington D.C (Reston, VA) on February 19-20, 2003. Many of the current issues were discussed and immediate solutions were not evident. I think the effort of the USFS to move forward on operational standards for taxonomic and mapping standards was recognized as a necessary and important contribution for current business requirements of inventory and mapping. The ESA Panel is not planning any activity in this field; rather, their primary emphasis is on the defined task of defining standards for Alliance and Association. These are not the same as: 1) dominance types, 2) detailed density classes beyond the physiognomic closed forest vs. open forest, 3) successional stages (stand size classes, stand age classes), or 4) vertical stand structure diversity. Interestingly, the Land Cover classifications were evidently not included in the original FGDC efforts, so that mapping work is not controlled by FGDC at this time. Evidently, the land (site) classification of PNV or habitat types was also left out of the original FGDC work so it is not controlled by FGDC standards. (Perhaps this is just as well! They are probably part of that list of "optional local classifications" considered necessary by some agencies, but not all agencies.) The national FS proposed standards are well crafted to define the importance of defining standard taxonomic units as a foundation for mapping (or at least describing) map units. The FS standards also demonstrate an attempt to use the NVCS standards as far as possible, and then do whatever is needed to meet FS business requirements. At this time, this evidently requires placing a physiognomic label on all map units based on FGDC 1997 or a revised version that is being proposed jointly by USFS (Dave Tart) and NatureServe.

Recommendations to Northern Region Vegetation Council:

1) Keep up the good work. Providing a test data base and documenting results of the workshop provide a basis to keep the ball rolling forward, rather than continually going around in circles.

2) Provide leadership in implementation of a demonstration of appropriate methods to classify existing vegetation and use that taxonomic classification as a clear foundation for delineating (where possible) and describing map units.

3) Document how your standards relate to NVCS and national USFS standards. You will be in a good

position to provide important feedback to the groups working on national standards.

4) Suggest that you build your classification database for dominance types at the basic, unadulterated level, rather than adopt SAF, Forest Survey, TSMRS, or any other cover types that have lumped types. These can be aggregated later to the "standard" mixed type lumping. Use the logic in Table 2 or 4 to define single level, dual level.

5) Suggest that "mix" be more specific. For example, name the dominant single species and then add -mix to it at the second level if no two qualifying species exceed 67 or 80 %. I don't like low-elevation mix, etc. because you already have that kind of descriptor in the H.T. groups. Then the only place you would get "Mix" would be if no single species had greater than 20% (very rare).

6) Make sure you define "relative" vs. "absolute" BA or CC. I used "relative" in my analysis to avoid some problems with absolute that you can see in the Excel spread sheet.

7) Size Class – I haven't tackled the complexities of this with your data. However, I am convinced that FIA standard summary techniques of size class (size class of greatest basal area through a complicated stocking algorithm) are inadequate to represent "structural stages of succession". Stages of succession are a critical component for existing vegetation classification, mapping and modeling. The wildlife professionals expended considerable effort in the late 1970's and 1980's to document wildlife habitat requirements by these stages. Arno's work on successional classification described stages in terms of age range and diameter of dominants and co-dominants. Therefore, I think we should call this "structural stage" rather than "size class" to avoid all the current confusion. Furthermore, the 1980's use of stages was a simple system that applied well to even-aged stand development. We need to expand this classification to represent two widespread conditions: 1) Stands with periodic disturbance that develop a continuous distribution of size and age (cohorts) with unique vertical and horizontal structural characteristics, and 2) Stands with partial removal (by insect, disease or partial cutting) that develop a distinct 2-level or 3-level strata where the overstory dominants are too few to be considered the dominant layer.

8) With your permission, I may want to use some of your data for inclusion in my current revision of the 1998 manuscript regarding proposed standards. I will be working on this during the month of March and asking some of your people for review and possible co-authorship.

Forest Cover Types based on Plurality--R. Pfister 1-02-03

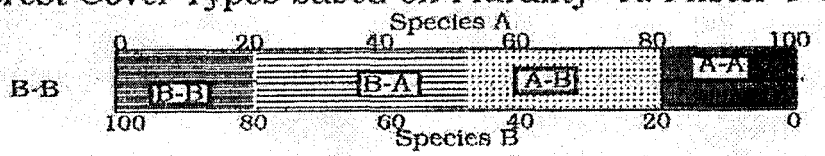

Figure 1--Combinations of two species; Pure if > 80 % relative BA or CC.

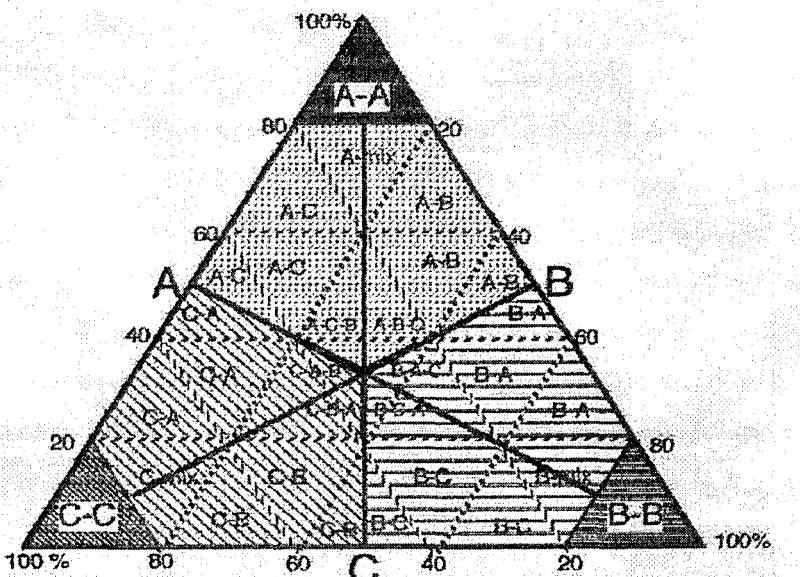

Figure 2 -- Combinations of three species; Pure if >80% relative BA or CC; minimum of 20% required to be included in type name ("mix" = > 20 of combination of other species not in type name because individually <20%).

Table 2 - Listing of all possible types in Figure 2 (with defining criteria):

Primary Types	Secondary Types	Tertiary Types
A (> B or C)	A-A (A> 80 %) A-B (A>B>20 %) A-C (A>C>20 %) A-mix (A>(B+C) >20 %)	A-B-C (A>B>C>20 %) A-C-B (A>C>B>20 %)
B (> A or C)	B-B (B> 80 %) B-A (B>A>20 %) B-C (B>C>20 %) B-mix (B>(A+C) >20 %)	B-A-C (B>A>C>20 %) B-C-A (B>C>A>20 %)
C (> A or B)	C-C (C> 80 %) C-A (C>A>20 %) C-B (C>B>20 %) C-mix (C>(A+B) >20 %)	C-A-B (C>A>B>20 %) C-B-A (C>B>A>20 %)
3 Primary Types	12 Types @ Sec level 15 Types for 2-level	6 Types @ Tertiary level 21 Types for three-level

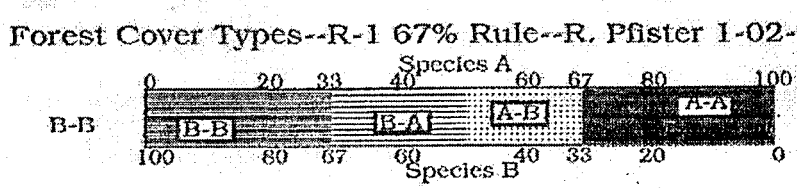

Figure 3--Combinations of two species; Pure if > 66 % relative BA or CC.

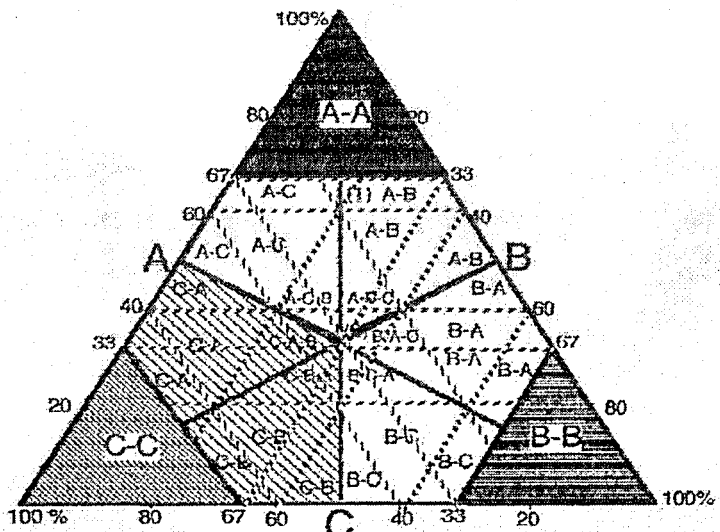

Figure 4 -- Combinations of three species; Pure if >66% relative BA or CC; minimum of 17 to 33% required to be included in type name (depending upon sum of other two species (e.g.(1) if A66 & B18, then C16 and is ignored; (2) if A34 & B34, then C=32 and is ignored)

Table 4 - Listing of all possible types in Figure 2 (with defining criteria):

Primary Types	Secondary Types	Tertiary Types
A (> B or C)	A-A (A> 66 %) A-B (A&B>66 %) A-C (A&C>66 %)	
B (> A or C)	B-B (B> 80 %) B-A (B>A>20 %) B-C (B>C>20 %) B-mix (B>(A+C) >20 %)	B-A-C (B>A>C>20 %) B-C-A (B>C>A>20 %)
C (> A or B)	C-C (C> 80 %) C-A (C>A>20 %) C-B (C>B>20 %) C-mix (C>(A+B) >20 %)	C-A-B (C>A>B>20 %) C-B-A (C>B>A>20 %)
3 Primary Types	12 Types @ Sec level 15 Types for 2-level	6 Types @ Tertiary level 21 Types for three-level

"Dom Types-R-1.xls"

Excel Spread Sheet of 10 stands from Field Trip – Click to open

Dominance Types for R-1 Vegetation Council October, 2002 Field Trip Stands
R. Pfister 2-22-03

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	Stand No:		453		455		356		998		330		509		169		541		821		522
2																					
3	Basal Area	LP	97	AF	56	DF	49	DF	65	DF	5	DF	62	DF	57	PP	51	PP	50	RC	132
4		DF	31	DF	54	PP	34	PP	29	WL	4	PP	32	WL	27	DF	32	DF	27	GF	67
5		AF	28	LP	50	LP	8			PP	1	GF	18	PP	23					WL	18
6				OT	7	AF	2			OT	2	WL	13	GF	17					DF	18
7						OT	4							OT	4					WH	11
8																				OT	6
9	Total BA		157		168		98		94		12		126		127		83		78		249
10																					
11	Relative BA	LP	64	AF	33	DF	50	DF	69			DF	49	DF	45	PP	61	PP	64	RC	53
12		DF	31	DF	32	PP	35	PP	31			PP	28	WL	21	DF	39	DF	36	GF	27
13		AF	75	LP	30	LP	8					GF	14	PP	18					WL	7
14												WL	10	GF	13					DF	6
15																				WH	4
16	Canopy Cover	LP	40	DF	32	DF	49	DF	52	DF	7	DF	43	DF	39	DF	39	DF	18	RC	114
17		DF	29	AF	28	PP	14	PP	16	PP	4	GF	14	GF	20	PP	22	PP	15	GF	58
18		AF	14	LP	27	LP	10			WL	2	PP	10	WL	9	WL	1			WH	19
19				OT	7	AF	1			OT	8	WL	6	PP	7					DF	9
20						OT	4							OT	2					WL	6
21	Total CC		84		140		79		88				74		77		82		34		209
22																					
23	Rel. CC	LP	48	DF	38	DF	62	DF	78			DF	58	DF	43	DF	53	DF	53	RC	66
24		DF	36	AF	31	PP	18	PP	24			GF	19	GF	28	PP	35	PP	44	GF	28
25		AF	17	LP	27	LP	13					PP	14	WL	12					WH	9
26				OT	8							WL	8	PP	9					DF	4
27																					
28	BA Dom. 60/20		LP-DF		AF-DF		DF-PP		DF-PP		DF-PP		DF-PP		DF-WL		PP-DF		PP-DF		RC-GF
29											(8 trees)										
30	BA Dom 66/20		LP-DF		AF-m		DF-PP		DF-DF		DF-PP		DF-PP		DF-m		PP-DF		PP-DF		RC-GF
31	(2spp>66)								(pure)		(stress)										
32	CC Dom 60/20		LP-DF		DF-AF		DF-m		DF-PP				DF-m		DF-GF		DF-PP		DF-PP		RC-GF
33											DF#-328										
34	CC Dom 66/20		LP-DF		DF-AF		DF-m		DF-DF		PP#263		DF-m		DF-GF		DF-PP		DF-PP		RC-GF
35	(2spp>66)								(pure)		WL#-58										
36																					
37	In 3 of 10 stands; all 4 rules gave same call. (BOLD)																				
38	In 7 of 10 stands, BA and CC gave the same dom. Species																				
39	In only two stands did the 60/20 vs. 66/20 rule give different results and that was for relative basal area, not relative canopy cover.																				

Stand/Cover/Layer Types for R-1 Vegetation Council October, 2002 Field Trip Stands R. Pfister 9-29-03

	A	B	C	D	E	F	G	H	I	J	K	L
1		Structural Stage/Stand No.	S453	S955	S356	S928	S330	P509	P109	P641	P921	P522
2	Data	Tally BA/0 = 4.5	0	0	10	4	3	0	5	8	0	32
3	Data	5 - 9.9	128	74	30	38	5	43	21	10	7	44
4	Data	10 - 14.9	27	61	26	26	2	52	49	14	31	56
5	Data	15 - 19.9	25	15	13	24	0	6	4	21	7	73
6	Data	20 - 24.9	10	13	9	2	2	8	2	9	12	29
7	Data	>25	8	7	10	0	0	15	6	20	21	35
8		Total	198	188	88	94	12	126	127	83	78	249
9	Data	#BA<15	19	0	3	13	0	1	25	14	3	73
10	Data	#BA>25	4	5	0	1	1	3	1	3	4	29
11	Data	#BA>25	2	1	1	0	0	4	0	5	4	35
12												
13		Size based on BA max	5 - 9.9	5 to 9	10 - 14.9	5 - 9.9	5 - 9.9	10 - 14.9	10 - 14.9	15 - 19.9	10 - 14.9	15 - 19.9
14		TSMRS Stand Detail	Multi-size	Multi-size	Multi-size	Multi-size	Seed	Multi-size	SAWT	Multi-size	SAWT	
15	DESC	Desc/Cov Dom Story	LMU	MTS	VLMU	MMU	SS	MTS	LTS	VLMU	M	LMU
16	DESC	Desc/Cov SMP	LMU	M	LMU	MMU	SS	MTS	LTS	LMU	M	LMU
17	FVS	FVS Shrt 1	9.7	12.1	35.1	12.3	2.3	13.2	15.2	12.5	14.5	16.1
18	FVS	FVS Shrt 2	0.2	0.1	11.4	3.8	8.7	0.2	0.1	n/a	0.3	3
19	FVS	FVS Shrt 3			1.9	0.1	1	n/a	n/a	n/a	n/a	0.1
20		FIA Size	>9"	>9"	5-9"	5-9"	SS>50%	>9"	>9"	>9"	>9"	>9"
21		Top 40 QMD	14.7	15.4	14.2	15.0	6.3	22"	15"	19"	24"	28"
22		Top BA (33%) QMD	18.4	18.5	15.48	18.0	10.8					
23		FVS 0.01 Percentile	20	19.2		19.4						
24		FVS 0.01 Percentile										
25												
26	Data	Tally Cover	0.84	90	79	58	21	73	77	52	34	209
27	FVS	FVS Cover	60	58	57	50	19	54	55	48	30	82
28	R1	Total Cover	30	287	27	27	14	32	22	35	12	182
29	DESC	Desc Dom Density	25-45	25-45	25-45	25-45	10-25	10-35	15-25	25-45	10-25	>65
30	DESC	Desc Shrp Density	25-45	25-45	25-45	25-45	25-45	25-45	25-45	25-45	25-45	>65
31	DESC	Desc Stand Dom Cov	30	28	30	28	14	21	24	40	12	247
32	FVS	FVS Strata 1 cover	58	58	3	57	1	54	55	48	29	73
33	FVS	FVS Strata 2 cover	3	1	55	7	7	1	0	n/a	0	
34	FVS	FVS Strata 3 cover			n/a		12	n/a	n/a			
35	FVS	FVS Structure (CHB)	1=SI	1=SI	1=SI	3=UR	3=UR	1=SI	2=SE	1=SI	1=SI	4=YM
36	FIA	FIA Stocking	60-100%	60-100	35-60	35-60	10-35	35-60	35-60	35-60	35-60	60-100
37	Desc	Volume CF	1334	5034	2526	2345	187	3818	3711	2056	2224	5894
38	Desc	Volume BF	5428	19813	9988	9874	815	14064	13159	11118	12333	32201
39	R1	PNYS-GRP	fail	fail	xericT	xericT	xericT	xericT	unknown	xericT	xericT	mesicT
40	R1	PVT	abig 1	abig 1	pairie 2	pairie 2	pairie 2	abgr 2	unknown	pairie 2	pairie 1	tshe
41	R1/Desc	SAF Cover Type	210	-1	210	210	210	210	210	237	237	229
42	R1	SLC Code	4830	4808	4812	4812	-1	-1	-1	4830	-1	-1
43	R1/Desc	RIPPELLE	LMU/2-F1	MU2-F1	LMU/2-B3	MTS/2-B2	SS/2-B2	MTS/2-C1	LTS/2-NIL	LMU/2-B2	MU2-B1	
44	R1/Desc	POT. OLD GROWTH	0	0	0	0	0	0	0	0	0	
45	R1	Combined Rel CC - QMD	1-5"	1-7"	1-5"	1-8"	1-2"	1-7"	1-8"	1-3"	1-11"	3-10"

Appendix 4 – Cover Page of Manuscript Only

Forest Stand Type Classification for Landscape Analysis in the Northern Rocky Mountains: A Review and Recommendations

(Draft -- RM Station Research Paper – 10/28/03)

Desired Authorship of Final Publication:

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